

Table SRS:

A new CAP18 feature

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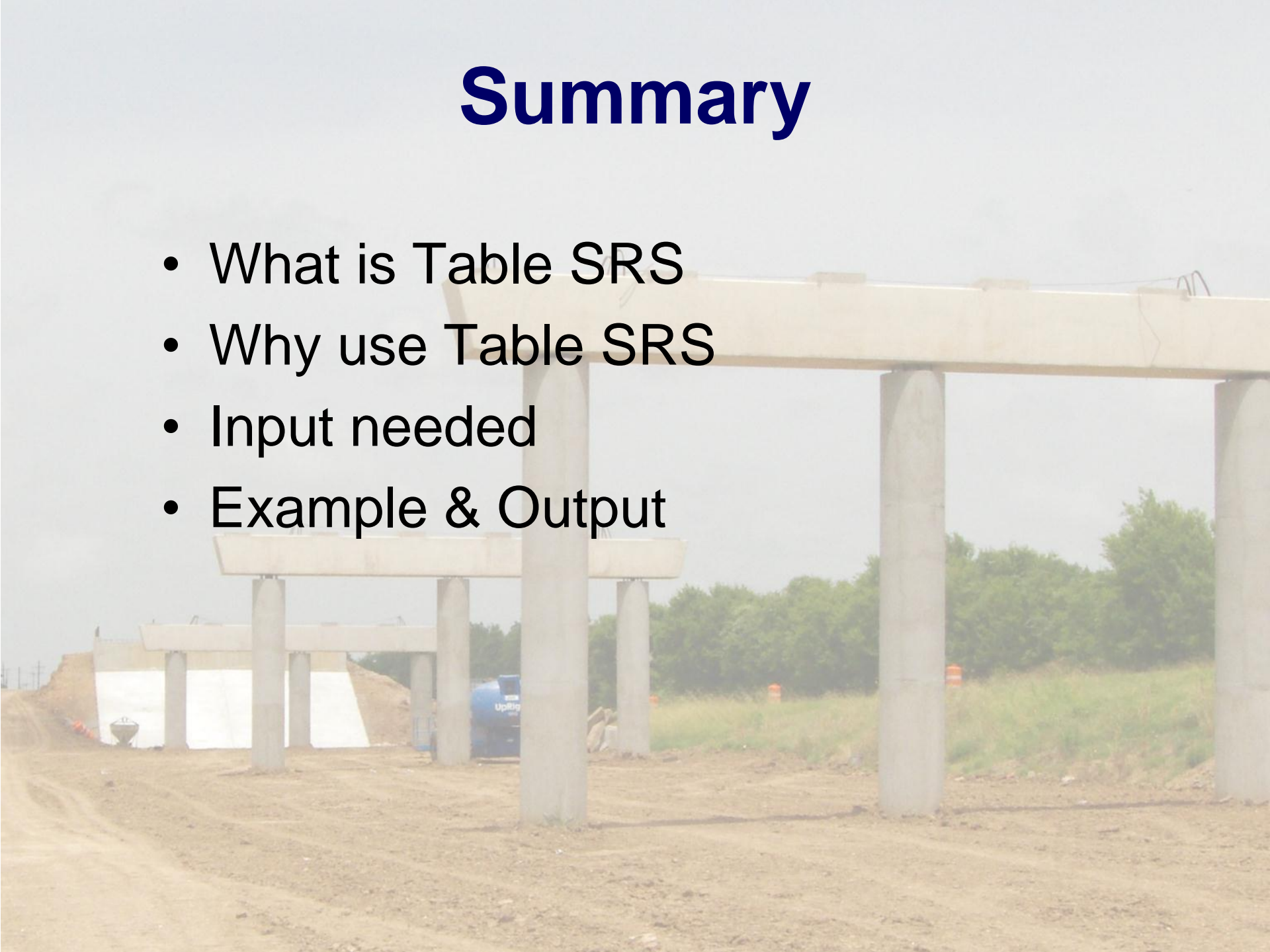
BRG Webinar

Feb 15, 2012



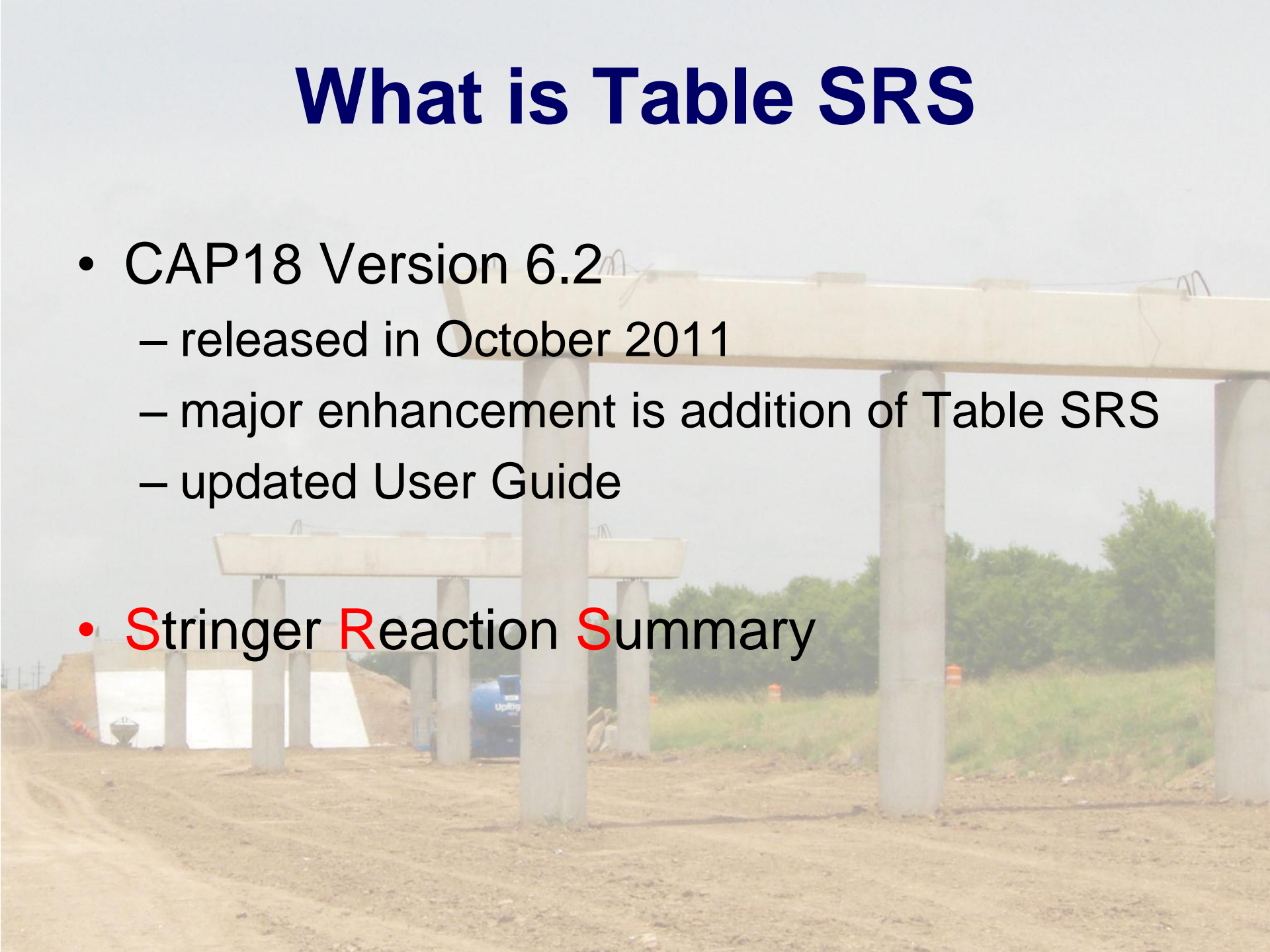
Summary

- What is Table SRS
- Why use Table SRS
- Input needed
- Example & Output



What is Table SRS

- CAP18 Version 6.2
 - released in October 2011
 - major enhancement is addition of Table SRS
 - updated User Guide
- Stringer Reaction Summary





USER GUIDE BENT CAP ANALYSIS (CAP18) Version 6.2

INPUT DATA INSTRUCTIONS

These notes may be used as a quick reference guide for input to the CAP18 program. More detailed instructions may be found in the Bent Cap User Manual [1] or the original research report [2] listed in [References](#), except that program enhancements since 1978 are discussed only herein.

GENERAL NOTES

Feet and kips for US Customary (English) units or meter and kN for SI (Metric) units are to be used throughout. Skew angle must be input in decimal degrees.

All data of 5 spaces or less must be whole integers and must be right justified. The only exception is that stringer stations may be expressed either as integers or decimally to the nearest one-tenth of an increment. All data of 10 spaces must be entered as decimal numbers with or without a right justified exponent. A decimal point must be entered. Blank spaces are interpreted as zeros. Any line beginning with a dollar sign "\$" is ignored by the program.

Any input error found by the program will cause that problem and any subsequent problem dependent on the erroneous problem to be abandoned. The program will skip to the next independent problem.

HEADER CARDS (three cards per run)

The first two cards contain run identification information. The first card has the File No. which can be used for data filing purposes. This card also indicates recommended information that should be included to identify the structure(s); however, the complete card may be used for any descriptive data as indicated by dashed lines. If the date field is left blank, the current date will be automatically printed. The second card includes the structure name or other descriptive information. It should not be left blank.

Check to ensure that each run has the above two header cards. Each problem in the file (which may encompass a series of problems) must also have a Problem card. Each Problem card in the file must have a short descriptive Problem No. such as BNT 5, as well as a field for other descriptive text input.

TABLE 1. – CONTROL DATA (one card for each problem)

New with CAP18, Version 6.2 is the option for the program to produce a report listing the maximum positive stringer live load reaction due to controlling single or multi-lane loads at each stringer along with the concomitant reactions at all other stringers. The results are output in Table SRS (Live-Load Stringer Reactions Summary (Working Stress)) which lists all non-zero values of these reactions if a "1" is placed in column 15 of Table 1 (see Input Guide section for the effect of placing a "99" using columns 14 and 15, in lieu of a "1" in column 15).

Each Table SRS contains three categories of data: (1) the lane order which produced the maximum reaction in a set; (2) the stringer stations at which non-zero stringer reactions are calculated—with "*" indicating which stringer reaction in each set of reactions is maximized; and (3) all non-zero values of the concomitant reactions of each set.

Table SRS data provides a means for the user to exploit the CAP18 capability to maximize multi-lane live load reactions to generate stringer reactions that may be input into a user selected structural analysis application that has more flexibility in terms of modeling the cap, in lieu of the simple CAP18 model of a

What is Table SRS

From User Guide:

New with CAP18, Version 6.2 is the option for the program to produce a report listing the maximum positive stringer live load reaction due to controlling single or multi-lane loads at each stringer along with the concomitant reactions at all other stringers.

Concomitant -
syn. coincident,
accompanying

What is Table SRS

From User Guide:

Each Table SRS contains three categories of data:

- (1) the lane order which produced the maximum reaction in a set;
- (2) the stringer stations at which non-zero stringer reaction are calculated - with “*” indicating which stringer in each set of reactions is maximized; and
- (3) all non-zero values of the concomitant reactions of each set.

TABLE SRS. LIVE-LOAD STRINGER REACTIONS SUMMARY (WORKING STRESS)
(* Denotes load-maximized station; Lanes loaded coefficients not applied)
(N = Lanes Loaded: 0 for random lane; 1 thru N for user-defined lanes)

N	----- Stations -----				----- Reactions (K) -----			
0	6*	18	38		70.3	62.3	1.8	
0	6	18*	38		10.4	90.9	33.2	
2	6	18	38*	58	14.7	99.6	125.6	29.0
0	38	58*	70		33.2	90.9	10.4	
0	58	70*	86		19.3	83.8	31.3	
0	70	86*			50.4	84.0		

What is Table SRS

Multiple
Presence
Factor

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0	38	58*	70		33.2	90.9	10.4	
0	58	70*	86		19.3	83.8	31.3	
0	70	86*			50.4	84.0		

- Output is Service Loads
 - Must apply load factors yourself
- No MPF
 - Why? Similar to Table 5 (Multi-Lane Loading Summary)
 - Must apply MPF yourself

Why use Table SRS



Why use Table SRS

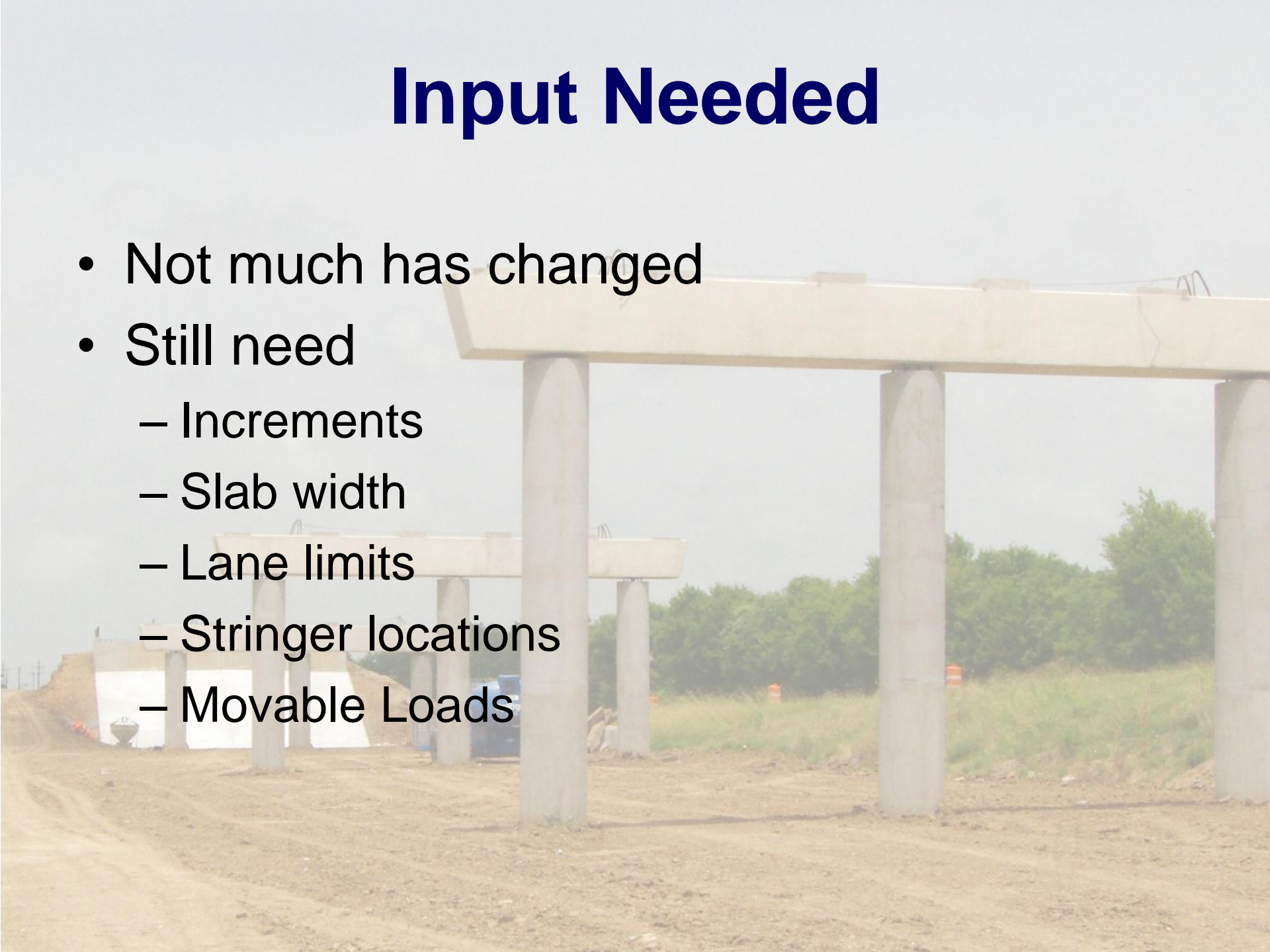
From User Guide:

Table SRS data provides a means for the user to exploit the CAP18 capability to maximize multi-lane live load reactions to generate stringer reactions that may be input into a user selected structural analysis application that has more flexibility...

- Acquire LL reactions from CAP18
- Model the bent using other software
 - (i.e. RISA, LUSAS, SAP, etc.)

Input Needed

- Not much has changed
- Still need
 - Increments
 - Slab width
 - Lane limits
 - Stringer locations
 - Movable Loads



- Table 1
 - 2 input changes

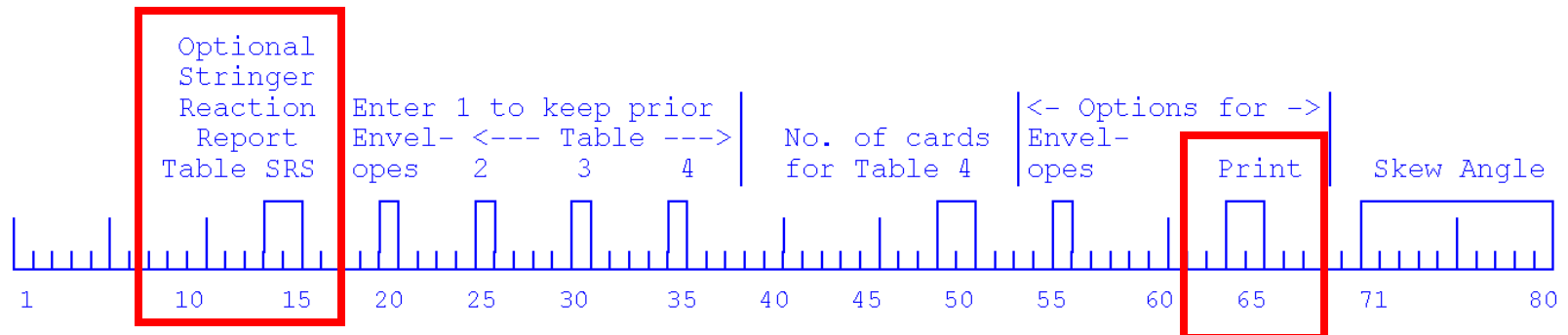
TABLE 1. CONTROL DATA (one card for each problem)

A code of 1 for the optional stringer reaction report will cause Table SRS (Live-Load Stringer Reactions Summary (Working Stress)) to be output, while a code of 99 will cause a full output of Table SRS and the analysis that is its basis.

Envelopes or data may be kept from the prior problem. A code of 1 for envelopes option will clear values created by the random lane load prior to multiple lane loadings.


Print eliminate options (options to eliminate one or more output tables from the output listing): -1 to omit Table 4A (Dead Load); -2 to omit Table 5 (Multi-Lane Loading Summary); -3 to omit both Table 4A and Table 5; -4 to omit Table 4A, Table 5, and Table 6; and -5 to omit Table 4A, Table 5, Table 6 and Table 7.

Skew angle is to be entered in decimal degrees.



Input Needed

- -1 omit Table 4A (Dead Load)
- -2 omit Table 5 (Multi-Lane Loading Summary)
- -3 omit 4A & 5
- -4 omit 4A, 5, & Table 6 (Envelope Max Values)
- -5 omit 4A, 5, 6, & Table 7 (Max Support Reactions)



use this when all you want is Table SRS

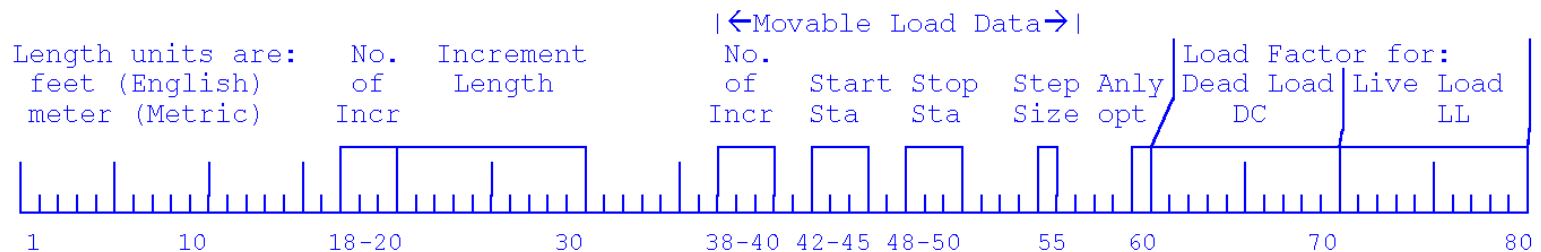
- Table 2
 - No changes
 - Input as normal

TABLE 2. CONSTANTS (two cards per problem - none if Table 2 is kept)

The cap may have up to 900 increments.

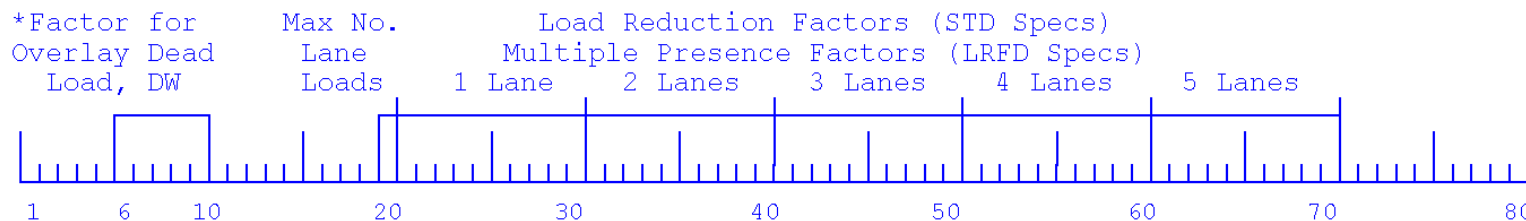
The movable load must fit within lane boundaries for multi-lane loadings. The start and stop stations are the placement positions for the zero station of the movable load pattern.

The analysis option is 1 for working stress, 2 for load factor, and 3 for both.



Typical Values

AASHTO LRFD Specifications	1.25	1.75
AASHTO Standard Specifications	1.3	2.167



*if no factor is input for the overlay dead load, the load factor input for Dead Load, DC, will be used for all input dead loads.

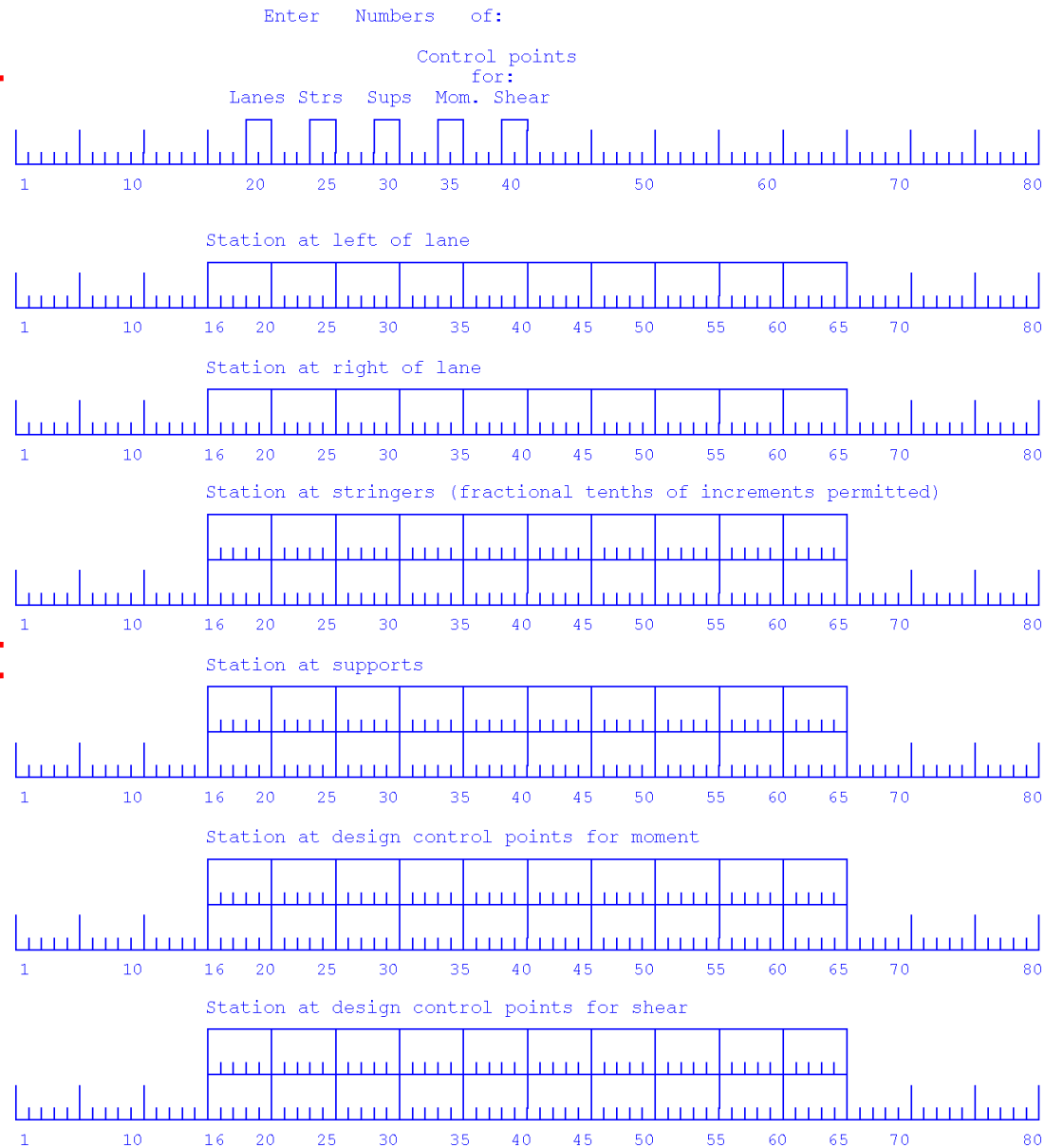
- Table 3

- Need

- Lanes
- Stringers

- Don't need

- Supports
- Control points



- Table 4
 - Input values for Moving Load

TABLE 4. STIFFNESS AND LOAD DATA (number of cards per Table 1 - kept data accumulated)

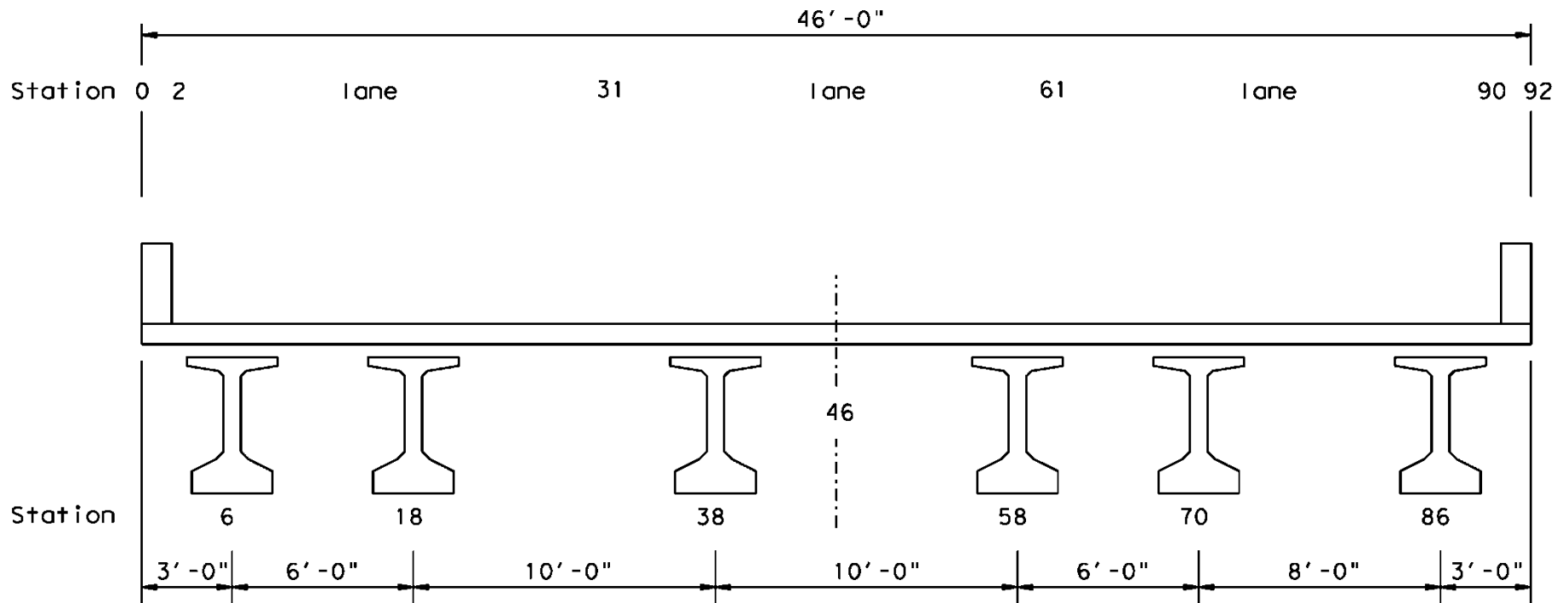
There is no restriction on the order of cards except within distribution sequences. Moving load data is entered as for other loads but is in reference to the stationing of the movable load pattern. Loads input as Cap and Stringer Loads are applied directly to the cap. Loads input as Slab and Sidewalk Loads and Moving Loads are transmitted to the cap through the stringers, if any. Concentrated overlay loads are applied directly to the cap while distributed overlay loads are automatically transmitted to the cap through the stringers.

|<----- Loads ----->|

	From Sta	To Sta	Enter 1 if cont'd	Bending Stiffness of Cap	Slab & Sidewalk Loads	Cap & Stringer Loads	Moving Loads	Overlay Loads, DW
Stiffness units:								
kip-ft ² (English)								
kN-m ² (Metric)								
Load units:								
kip/Sta (English)								
kN/Sta (metric)								
Downward loads are negative								

1 10 15 18-20 23-25 30 35 40 45 50 55 60 65 70 75 80

Example



Example

Table 1

Optional Stringer Reaction Report Table SRS	Enter 1 to keep prior Envel- opes	<--- Table --->				No. of cards for Table 4	<- Options for -> Envel- opes		Print	Skew Angle	
	2	3	4								

Table 2

Length units are:		No.	Increment	←Movable Load Data→					Load Factor for:	
feet (English)	meter (Metric)	of	of Length	No.	Start	Stop	Step	Only	Dead Load	Live Load
		Incr		Incr	Sta	Sta	Size	opt	DC	LL
1	10	18-20	30	38-40	42-45	48-50	55	60	70	80
		92	0.5	20	2	70	1	1	1.25	1.75

*Factor for	Max No.	Load Reduction Factors (STD Specs)							
Overlay Dead	Lane	Multiple Presence Factors (LRFD Specs)							
Load, DW	Loads	1 Lane	2 Lanes	3 Lanes	4 Lanes	5 Lanes			
1	6	10	20	30	40	50	60	70	80
		3	1.2	1.0	0.85	0.65	0.65		

*if no factor is input for the overlay dead load, the load factor input for Dead Load, DC, will be used for all input dead loads.

Table 3

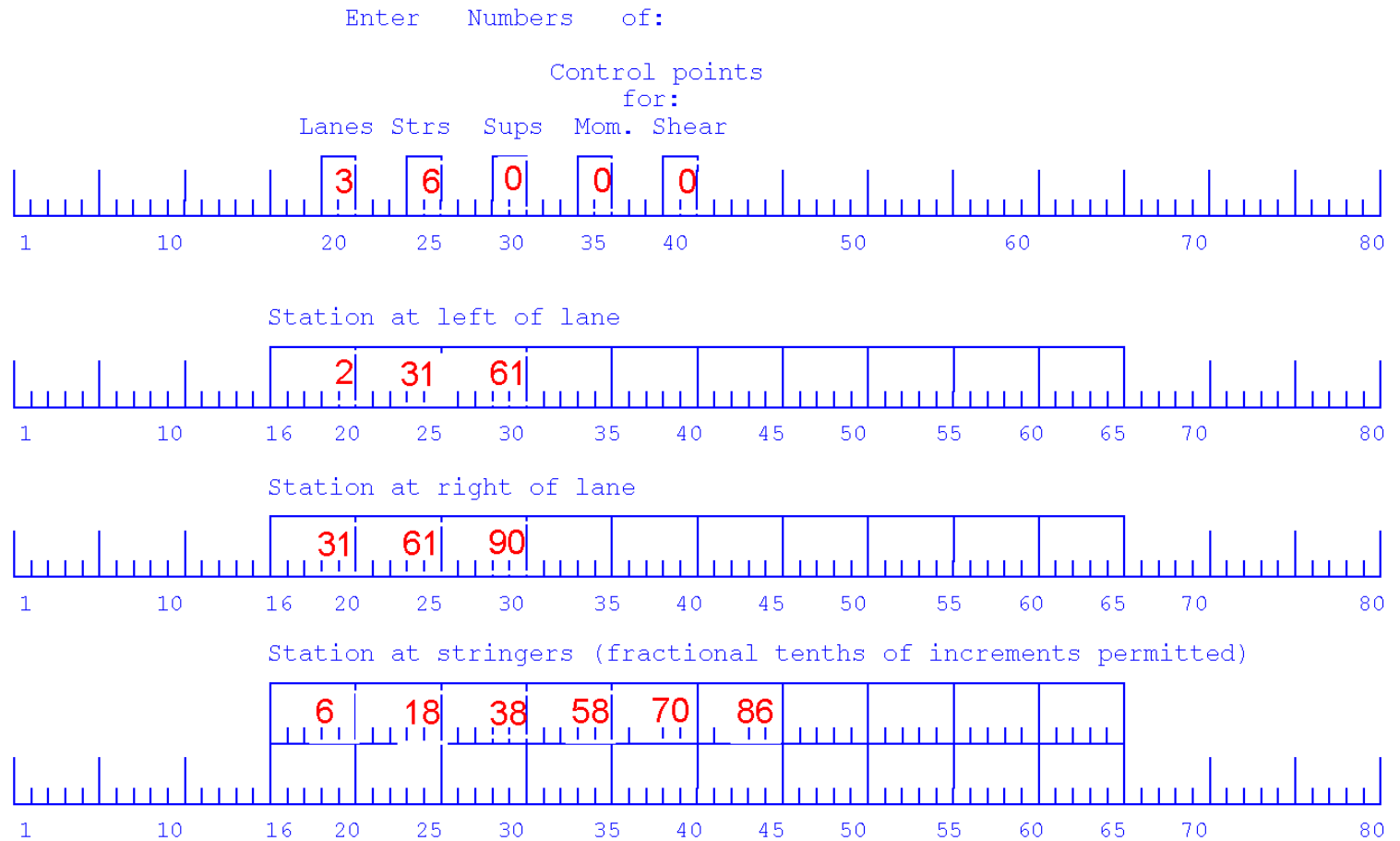


Table 4

	<----- Loads ----->							
	From Sta	To Sta	Enter 1 if cont'd	Bending Stiffness of Cap	Slab & Sidewalk Loads	Cap & Stringer Loads	Moving Loads	Overlay Loads, DW
Stiffness units:								
kip-ft ² (English)	0	20					-4.59	
kN-m ² (Metric)	4	4					-21.33	
Load units:								
kips/Sta(English)	16	16					-21.33	

Programmer's File Editor - [example.lis]

File Edit Options Template Execute Macro Window Help

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PSF NO COUNTY HIGHWAY PD- CONTROL- CODED
1 ANY COUNTY NO IPE SECTION-JOB BY DATE
AEE FEB 15, 2012

WEBINAR WAY OVERPASS
PROB 1

ENGLISH SYSTEM UNITS

TABLE 1. CONTROL DATA

OPTION TO PRINT TABLE SRS (1=YES) 1

ENVELOPES OF MAXIMUMS TABLE NUMBER
2 3 4
KEEP FROM PRECEDING PROBLEM (1=YES) 0 0 0
CARDS INPUT THIS PROBLEM 3

OPTION TO CLEAR ENVELOPES BEFORE LANE LOADINGS (1=YES) 0

OPTION TO OMIT PRINT FOR TABLES (TABLE DESIGNATIONS IN PARENTHESES)
-1(4A), -2(5) -3(4A,5), -4(4A,5,6), -5(4A,5,6,7): -5

SKREW ANGLE, DEGREES 0.000

TABLE 2. CONSTANTS

NUMBER OF INCREMENTS FOR SLAB AND CAP 92
INCREMENT LENGTH, FT 0.500
NUMBER OF INCREMENTS FOR MOVABLE LOAD 20
START POSITION OF MOVABLE-LOAD STA ZERO 2
STOP POSITION OF MOVABLE-LOAD STA ZERO 70
NUMBER OF INCREMENTS BETWEEN EACH POSITION OF MOVABLE LOAD 1

ANALYSIS OPTION (1=WORKING STRESS, 2=LOAD FACTOR, 3=BOTH) 1

MAXIMUM NUMBER OF LANES TO BE LOADED SIMULTANEOUSLY 3

LIST OF LOAD COEFFICIENTS CORRESPONDING TO NUMBER OF LANES LOADED
1 2 3 4 5
1.200 1.000 0.850

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PROB 1
(CONTINUED)

TABLE 3. LISTS OF STATIONS

	NUM OF LANES	NUM OF STRINGERS	NUM OF SUPPORTS	NUM HOH CONTR PTS	NUM SHEAR CONTR PTS
TOTAL	3	6	0	0	0
LANE LEFT	2	31	61		
LANE RIGHT	31	61	90		
STRINGERS	6.0	18.0	38.0	58.0	70.0
				86.0	

Programmer's File Editor - [example.lis]

File Edit Options Template Execute Macro Window Help

TABLE 4. STIFFNESS AND LOAD DATA

FIXED-OR-MOVABLE			FIXED-POSITION DATA			MOVABLE-POSITION	
STA FROM	STA TO	COND IF=1	CAP BENDING STIFFNESS (K-FT*FT)	SIDEWALK, STRINGER, SLAB LOADS (K)	STRINGER, CAP LOADS (K)	OVERLAY LOADS (K)	SLAB LOADS (K)
0	20	0	0.000	0.000	0.000	0.000	-4.590
4	4	0	0.000	0.000	0.000	0.000	-21.330
16	16	0	0.000	0.000	0.000	0.000	-21.330

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PROB 1
(CONTINUED)

TABLE 4A. DEAD LOAD RESULTS (WORKING STRESS)
TABLE 4A OUTPUT OMITTED FROM THIS PROBLEM

TABLE 5. MULTI-LANE LOADING SUMMARY (WORKING STRESS)
TABLE 5 OUTPUT OMITTED FROM THIS PROBLEM

TABLE 6. ENVELOPES OF MAXIMUM VALUES (WORKING STRESS)
TABLE 6 OUTPUT OMITTED FROM THIS PROBLEM

TABLE 7. MAXIMUM SUPPORT REACTIONS (WORKING STRESS)
TABLE 7 OUTPUT OMITTED FROM THIS PROBLEM

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PROB 1
(CONTINUED)

TABLE SRS. LIVE-LOAD STRINGER REACTIONS SUMMARY (WORKING STRESS)
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0 70 86*		50.4	84.0		

Output

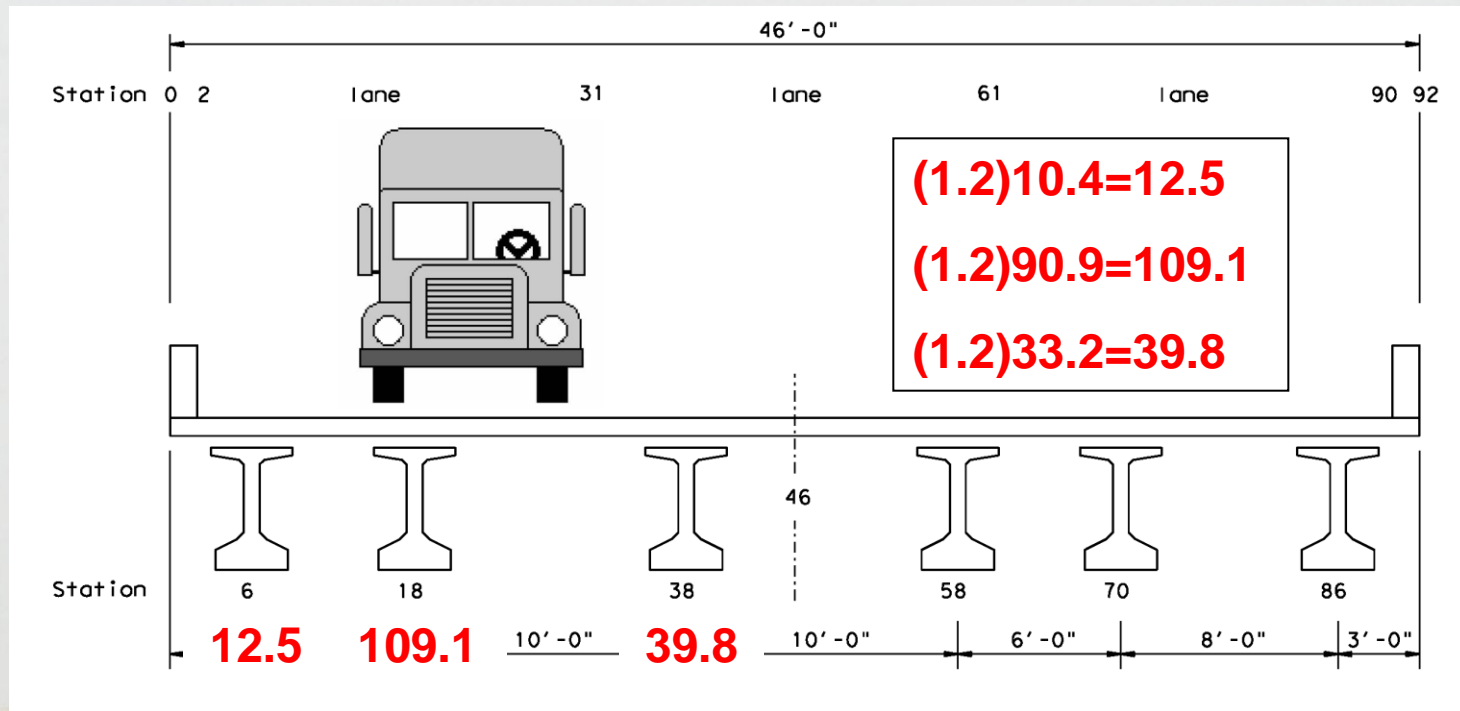


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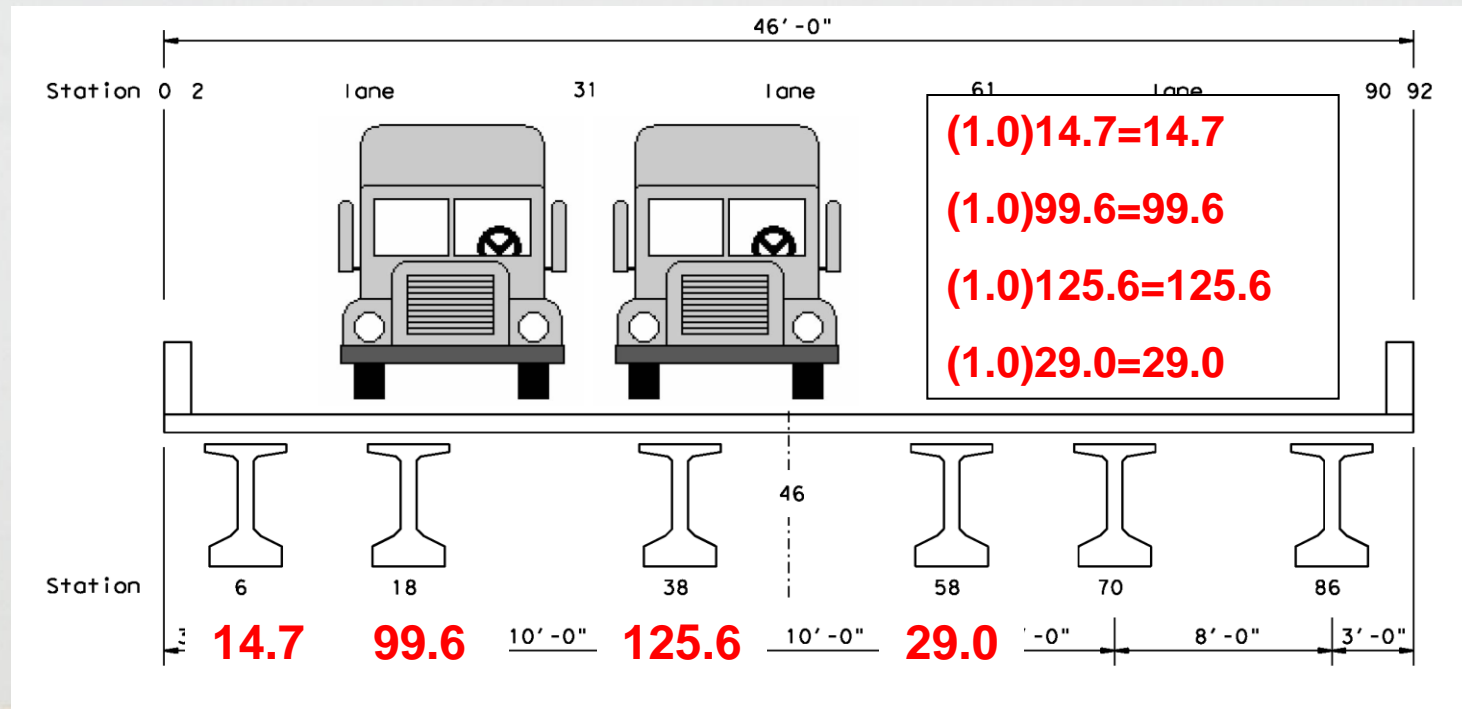


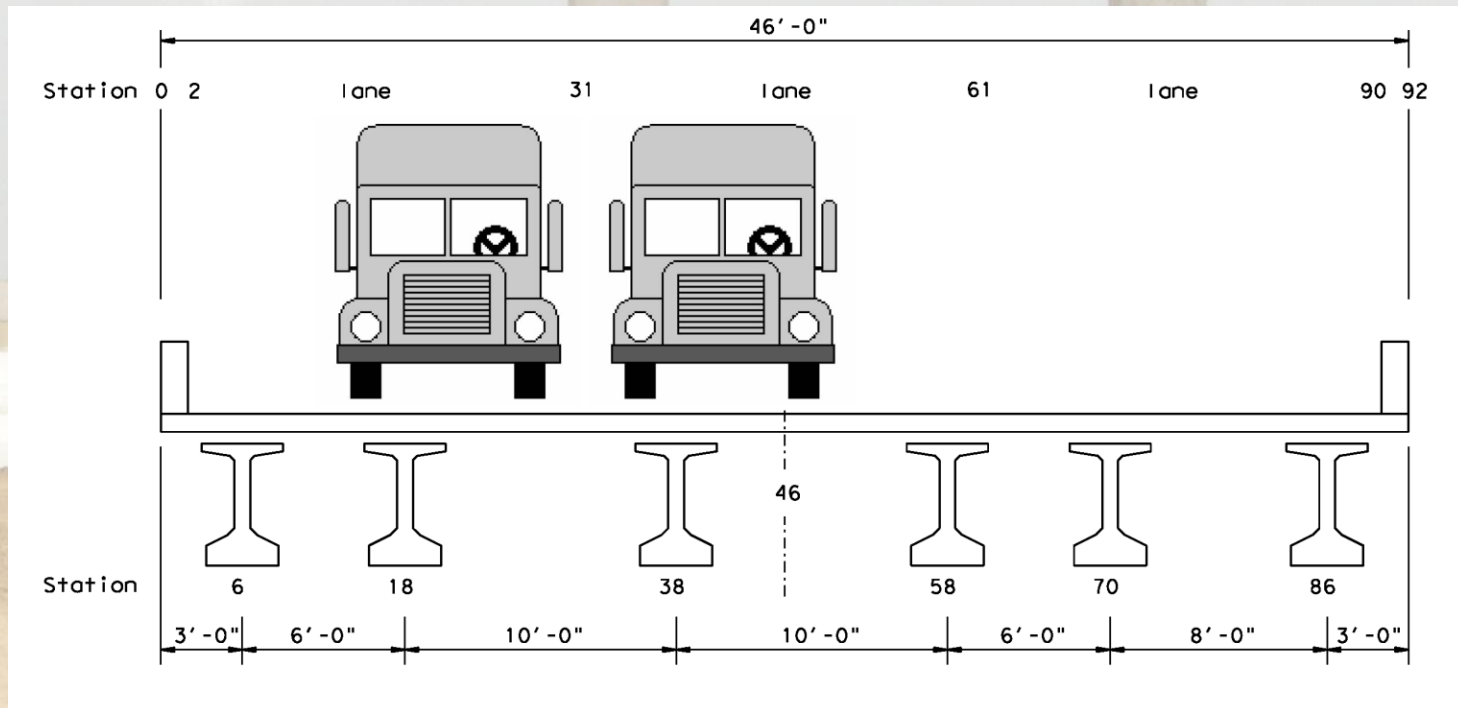
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0	58	70*	86		19.3	83.8	31.3	
0	70	86*			50.4	84.0		

Output

- How did I know position of trucks?
 - Run a Table 5 (Multi-Lane Loading Summary)
 - Place support at each stringer location



Output

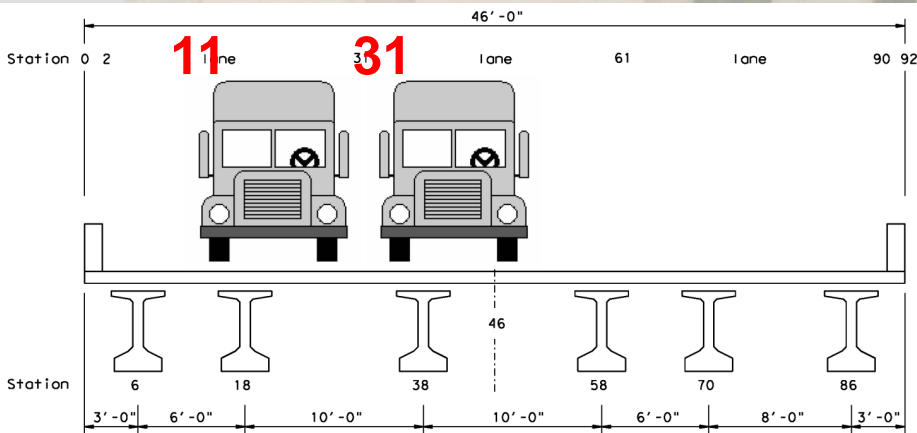
- Table 5 (Multi-Lane Loading Summary)
- Support at each stringer location
- Can only get the maximized reaction from this table

TABLE 5. MULTI-LANE LOADING SUMMARY (WORKING STRESS)
(*--CRITICAL NUMBER OF LANE LOADS)

REACTION (K)

AT STA	DEAD LD EFFECT	LANE ORDER	POSITIVE MAXIMUM	LOAD AT LANE STA	LANE ORDER	NEGATIVE MAXIMUM
6	0.0	0	70.3	1 2	0	0.0
		1	70.3	1 2	1	0.0
		2	0.0		2	0.0
		0*			0*	
18	0.0	0	90.9	0 12	0	0.0
		1	90.8	1 11	1	0.0
		2	8.8	2 31	2	0.0
		0*			0*	
38	0.0	0	98.7	0 28	0	0.0
		1	96.6	2 31	1	0.0
		2	29.0	1 11	2	0.0
		2*			0*	
58	0.0	0	90.9	0 44	0	0.0
		1	84.6	2 41		0.0
		2	24.4	3 61		0.0
		0*				
70	0.0	0	83.8	3 62		0.0
		1	83.8	3 62		0.0
		2	1.7	2 41		0.0
		0*				
86	0.0	0	84.0	3 70	0	0.0
		1	84.0	3 70	1	0.0
		2	0.0		2	0.0
		0*			0*	

$$\begin{aligned}
 &96.6 \\
 &+ 29.0 \\
 &\hline
 &125.6
 \end{aligned}$$



Summary

- Use Table SRS to get max LL stringer reactions & concomitant reactions
- Must apply load factors and MPF yourself
- Use results as input for more sophisticated analysis
- Minor input changes
- Combine with Table 5 to get complete LL picture

Credits

- Tim Bradberry, BRG
- Danny Bradley, TSD
- Jorge Carrasco, BRG



Have Questions??

- Read CAP18 User Guide
- Check the Support Information document
- Amy Eskridge, BRG
 - (512) 416-2261
 - Amy.Eskridge@txdot.gov

